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(54) **Automatic multiple-decanting centrifuge**

Zentrifuge für automatische Mehrfachdekantierung

Centrifugeuse pour décantation multiple automatique

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Description

[0001] The present invention relates to apparatus for treating physiological products. In one of its forms, the invention relates to apparatus and a method using automatic, multiple decanting with centrifugation. In a preferred embodiment, an automated procedure separates fibrinogen from blood.

[0002] The separation of components through centrifugation is well known. For example, in the medical field it is common to subject a sample of blood to centrifugation to produce a precipitate of cellular material and a supernatant of plasma. The plasma is then decanted to complete the separation of these components.

[0003] United States patents 5,178,602 (Wells) and 5,047,004 (Wells) show an automated centrifuge, which includes a structure for holding a centrifuge tube, after centrifugation, in a position that allows the supernatant to drain from the tube and into another container by gravity. The holding structure shown in these patents comprises a locking mechanism mounted for axial movement with respect to the axis of rotation of the centrifuge. An electromagnet that is easily controlled causes the axial movement.

[0004] It is also known to decant a supernatant by the process of centrifugal draining. According to that process, a centrifuge rotates a centrifuge tube while the tube is held in a position such that the supernatant is drained from the tube by centrifugal forces.

[0005] A centrifuge for washing cells is shown in DE-A-4323844. Cells and washing fluid are placed in a number of separate tubes which are rotated in a centrifuge. After centrifugation, the tubes are moved to a partially inverted position so that the used washing fluid runs from the tubes into a number of open canals, from which the fluid flows into an annular ring for discharge.

[0006] Fibrin sealants for treating wounds are known and are typically produced by combining a fibrinogen/Factor XIII component with bovine thrombin. When these are mixed, a fibrin tissue adhesive results, which is applied to the wound. Descriptions of compositions for use as tissue sealants are given in United States patents 5,292,362 and 5,209,776 (Bass et al.). The fibrinogen is obtained from plasma, either pooled or autologous, and cryoprecipitation is one known technique for separating fibrinogen from plasma. One cryoprecipitation technique is described in United States patent 5,318,524 and includes the centrifugation of thawing plasma to produce a precipitate containing fibrinogen/Factor XIII. Other techniques for producing fibrinogen/Factor XIII include inducing precipitation of the component by addition of such agents as Ammonium Sulfate or polyethylene glycol (PEG) to blood plasma.

[0007] Several known chemical procedures include repeated steps of physical separation between two or more components. Separation based on density differences between the components is often by centrifugation, and the resulting supernatant is decanted to complete the separation. Each step provides an opportunity for error, which would be reduced by automation of the process.

[0008] In one embodiment of the invention, chemical procedures requiring several centrifugation steps are automated, to reduce the time required by a clinician and eliminate the potential for errors. Apparatus in accordance with the invention may comprises a multiple-chamber container and a centrifuge designed to receive the container and subject its contents to predetermined centrifugation steps as well as gravity and centrifugal decanting of the supernatant.

[0009] The present invention is directed to apparatus for treating physiological products comprising a container having a base forming a plurality of sterile chambers, each chamber having a bottom and a top, characterised in that the container further comprises a bridge connecting the two or at least two of the chambers and arranged to provide a sterile fluid channel from a first of the said two or at least two chambers to a second of the said two or at least two chambers when the container is in a predetermined orientation, a lid closing the top of each of the chambers, and openings that provide access to the chambers while maintaining sterility.

[0010] In an embodiment of the present invention, a first chamber is designed to receive a liquid, such as human blood. A second chamber is located adjacent to the first chamber, and the bridge between the chambers is such that a supernatant in the first chamber will flow through the bridge and be drained into the second chamber by gravity when the container is held in the proper orientation.

[0011] Advantageously, the plurality of sterile chambers and the bridge comprise a molded base part.

[0012] Preferably, the container is substantially rigid.

[0013] Advantageously, the apparatus further comprises a separation disk in one of the chambers.

[0014] In a preferred embodiment, the plurality of chambers comprise first and second adjacent chambers having adjacent sidewalls and the bridge is formed at the tops of the adjacent sidewalls.

[0015] Advantageously, the apparatus further comprises a centrifuge having a frame removably receiving the container and allowing the container to assume a first orientation wherein a product in one of the chambers is subjected to centrifugation, and the predetermined orientation wherein fluid in the said first of the said two or at least two chambers flows along the fluid channel to the second of the said two or at least two chambers.

[0016] Preferably, the frame is pivotally mounted to a centrifuge rotor.

[0017] In a preferred embodiment, the apparatus further comprises a locking plate movable between free and locking positions and wherein the plate allows the container to assume the said first orientation when in the free position and holds the container in the predetermined position when in the locking position.

[0018] Advantageously, the apparatus further comprises an electromagnet for moving the locking plate to one of the locking and free positions.

[0019] Preferably, the locking plate engages the frame.

[0020] Alternatively, the electro-magnet operates a disk mounted for movement axially with respect to the axis of rotation of the frame. The centrifuge is preferably operated under the control of an electronic circuit, which may include a programmed array logic (PAL) or other circuitry, that causes the rotor to operate in accordance with a predetermined program and controls the locking plate such that it locks the container in predetermined orientations in conjunction with operation of the rotor.

[0021] In a preferred embodiment, the frame further allows the container to assume a second orientation wherein fluid in the second of the said two or at least two chambers flows to the said first of the said two or at least two chambers.

[0022] Advantageously, the fluid in the said first of the said two or at least two chambers flows to the said second of the said two or at least two chambers by gravity draining when the container is in the predetermined orientation and fluid in the said second of the said two or at least two chambers flows to the said first of the said two or at least two chambers by centrifugal transfer when the container is in the second orientation.

[0023] Preferably, the apparatus further comprises a locking plate that moves between locking and free positions for controlling the orientation of the frame.

[0024] While many different programs for operation of the centrifuge can be developed, depending on the desired results, a preferred operation is for the production of autologous fibrinogen. Prior techniques for production of fibrinogen require several distinct steps, each of which requires attention and provides an opportunity for error. These steps include separation of plasma from cellular components, treatment of the plasma with a precipitating agent, and separation of a fibrinogen precipitate "pellet" from the plasma. The separation of plasma from blood and the separation of the fibrinogen pellet from plasma typically require centrifugation first of the blood and then of the plasma with addition of at least one precipitating agent between the steps. Thus, the production of fibrinogen in the prior art has been complex and error-prone.

[0025] Accordingly, the present invention is further directed to a method for automatic separation of components characterised by placing a sterile, unitary container having first and second chambers in a centrifuge, subjecting the container to centrifugation, and locking the container in a first orientation such that a supernatant in the said first chamber flows into the said second chamber.

[0026] Preferably, the container is removable from the centrifuge.

[0027] Advantageously, the method further comprises subjecting the container to a second centrifugation.

[0028] Preferably, the method further comprises locking the container in a second orientation such that a supernatant in the said second chamber flows to the said first chamber.

[0029] In a preferred embodiment, the supernatant in the said first chamber flows to the said second chamber by gravity draining when the container is in the said first orientation and the supernatant in the said second chamber flows to the said first chamber by centrifugal transfer when the container is in the said second orientation.

[0030] Advantageously, the method further comprises placing blood in the said first chamber.

[0031] Preferably, the method further comprises placing an agent for precipitating fibrinogen from plasma in the said second chamber.

[0032] In an embodiment of the invention, a patient's blood is placed in the first chamber of the container, and a precipitation agent is placed in the second of the chambers. The container is then placed in the frame of the centrifuge, and the control circuit is activated to initiate the operation of the centrifuge. The centrifuge first rotates the container for a time period that has been determined to be adequate for separating the cellular components from the supernatant plasma. During this time, the frame will have rotated outwardly substantially due to centrifugal forces on the container. While the frame is in the outwardly rotated position, the locking plate is activated to lock it there. The rotation of the frame is then terminated. As the rotational velocity of the frame decreases, the supernatant fluid, being no longer subject to the centrifugal forces, flows out of the first chamber and into the second chamber by gravity. The cellular component is more viscous and, thus, flows toward the second chamber at a rate less than that of the plasma. Preferably, however, a divider in the form of a disk is placed in the chamber to restrict the flow of the cellular components. The disk is at a depth that provides a predetermined volume of plasma, which is normally near the expected boundary between the supernatant and cellular components. After a period of time that has been determined to allow an adequate amount of the plasma to flow into the second chamber, the locking plate is deactivated to release the container, whereby it assumes an upright position with the cellular component remaining in the first chamber and the plasma now in the second chamber. The frame is then alternately activated and deactivated for short intervals to mix the plasma with the precipitating agent in the second chamber. Interaction between the precipitating agent and the plasma initiates precipitation of fibrinogen and Factor XIII from the plasma. The frame is then again rotated to accelerate the precipitation of the fibrinogen/Factor XIII and to create a pellet in the bottom of the second chamber. As a final step, the locking plate is again activated to lock the container in a position such that the supernatant resulting from precipitation of the fibrinogen is decanted by centrifugal draining into the first chamber. In

this step, the container is held substantially upright, and the frame is rotated to apply centrifugal forces to the supernatant, whereby it flows through the bridge between the chambers and into the first chamber. The locking plate is then deactivated, the container removed from the centrifuge, and the fibrinogen/Factor XIII removed from the second chamber for further processing. In a preferred embodiment, the fibrinogen/Factor XIII is then reconstituted, combined with thrombin, and applied to a patient to treat a wound.

[0033] An example of apparatus made in accordance with the present invention and of the method according to the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a container and centrifuge made in accordance with the present invention;
Figure 2 shows a vertical cross section of a preferred embodiment of a container;
Figures 3a and 3b show partial vertical cross sections of the centrifuge shown in Figure 1; and
Figures 4a to 4f show schematic diagrams illustrating a preferred method of operation of the centrifuge.

[0034] With reference to Figures 1 and 2 of the drawings, a centrifuge 2 is designed to receive a container 4 in accordance with the invention. The centrifuge is capable of subjecting the container to a series of steps that will be described in detail below. The container includes at least two chambers, 6 and 8. Chamber 6 is designed to receive a first fluid to be treated, such as blood. Chamber 8 is designed to receive fluids that have been decanted from chamber 6, such as a supernatant plasma resulting from centrifugation of blood in chamber 6.

[0035] A preferred form of the container is shown in detail in figure 2. As shown, the container comprises three primary parts. A base part is preferably molded and includes the chambers 6 and 8 and a bridge 7, which connects the two chambers. A lid 11, also preferably molded, fits over the tops of the chambers to close them The lid includes cup shaped extensions 12 and 14, each of which is centrally aligned with a respective one of the chambers 6 and 8. Extension 12 has a centrally located opening 13, while extension 14 has a centrally located opening 15. The openings receive syringe needles to permit fluids to be injected into the chambers or withdrawn therefrom. Membranes 16 and 17 cover the openings 13 and 15 to maintain sterility. The membranes are preferably heat sealed into the extensions 12 and 14 during construction by providing a cavity for receiving the membranes. After a membrane is inserted, the upper edges of the cavity are folded over and welded, e.g, ultrasonically, to retain the membrane.

[0036] The lid also includes a bridge T that cooperates with bridge 7 in the base to form a fluid channel 18, connecting chambers 6 and 8. As shown, the bridge 7 extends above the tops of the chambers 6 and 8 to prevent communication between the chambers by "splashing." Intentional fluid communication between the two chambers will be described in detail below.

[0037] A separation disk 20 is preferably placed in chamber 6 near, but always above, the expected vertical position of the boundary between supernatant plasma and cellular components after a first centrifugation of a blood sample. The hematocrit is known to vary among individuals, and the exact amount of plasma that will result from a blood sample cannot be accurately specified without prior testing of the sample. Thus, disk 20 is located such that the plasma above the disk after centrifugation of a predetermined volume of blood is a predetermined amount of plasma. The upper surface of the disk 20 is tapered toward an edge, and the edge includes at least one groove 22 that allows fluid communication between the parts of the chamber 6 that are above and below the disk 20.

[0038] In a preferred embodiment, a cylindrical support 24 is attached to the lower surface of the disk to set the location ofthe disk during assembly.

[0039] A hollow tube 26 is provided to facilitate introduction of the blood sample to the portion of the chamber 6 that is below the disk 20. The tube 26 extends from just below the opening 13 through disk 20. Thus, a syringe needle inserted through opening 13 pierces membrane 16 and communicates with tube 26 to allow injection ofthe blood sample into the bottom of the chamber 6, The groove 22 permits vertical movement of the plasma and cellular components during centrifugation but retards movement of the cellular components during decanting. Also, an air vent 27 is provided for chamber 8 to facilitate introduction and withdrawal of fluids.

[0040] In use, a container 4 is placed in a holder on the rotor of the centrifuge as indicated in figure 1. To balance the rotor, two such containers are preferably placed in the centrifuge in diametrically opposed positions. Of course, only one container may be used and a weight or "dummy" container used to balance the rotor.

[0041] Figures 3a and 3b are partial cross sections of a preferred embodiment of a centrifuge showing the container locked in two different positions. A rotor shaft 28 is connected to a motor (not shown), which rotates the shaft. A rotor 30 is mounted to the shaft for rotation and has a frame 32 pivotally mounted to the rotor 30 at pivot connection 34. The top surface (not shown) of the frame 32 has two circular openings for receiving the chambers 6 and 8 whereby the container can be placed in the frame such that the contents of the container will be subjected to centrifugal forces as the rotor is rotated. A bias spring 35 ensures that the frame 32 will pivot to an upright position when centrifugation is terminated. The frame 32 may also be shaped to reduce wind resistance, as known in the art.

[0042] A locking plate 36 is mounted coaxially with the shaft 28 for engaging the frame 32 to lock the container in desired orientations. The plate and the mechanism

for controlling the positions of the plate may be the substantially the same as that shown in my previous United States patent number 5,178,602. For example, an electromagnet 38 may be provided to control the position of the locking plate by action on a permanent magnet 40, which is attached to the locking plate.

[0043] Preferably, the electromagnet 38 and magnet 40 are positioned such that the locking plate can be placed in either of two positions. In a first position, shown in phantom lines, the plate does not engage the frame 32, and the frame 32 is free to rotate about pivot 34. In a second position, shown in solid lines at 36', the locking plate engages one of two parts of the frame 32 to hold it in one of two selected orientations. In the position shown in figure 3a, a lip of the plate engages a protuberance 42 on the frame 32 to lock the container in the orientation shown in figure 3a. In the position shown in figure 3b, the plate 36 engages an upper edge of the frame 32 to lock the container in the tilted position shown in figure 3a. The locking plate preferably rotates with the rotor whereby it can be moved to engage the frame during centrifugation of the contents of the container.

[0044] The operation of the centrifuge in a preferred embodiment of the invention will be described with regard to figures 4a through 4f. In a first step, blood is introduced into chamber 6 of the container through opening 13. The blood has preferably been obtained from a patient, but it may be pooled or obtained from another. A precipitating agent 43, e.g., PEG, is then placed in chamber 8, preferably by injection through opening 15. The container with blood and precipitating agent are then placed in the centrifuge for automated operation.

[0045] In the first step of automated operation, the container is allowed to swing freely as the blood is subjected to centrifugation. As illustrated in figure 4a, the cellular component 44 of the blood will be separated from the plasma component 46 in this step. After a predetermined time period, e.g., five minutes, the locking plate 36 is moved to a position shown at 36' whereby the container 4 is held in the position shown in figures 3b and 4b, and rotation of the rotor is stopped. In this position, the plasma component 46 flows through channel 18 by the force of gravity. The chamber is held in the position of figure 4b for preferably about 3 seconds, which is adequate to allow the plasma to drain by gravity into the chamber 8 but is not so long that the more viscous cellular component 44 drains into the chamber 8. The plasma 44 and precipitating agent 43, which was previously placed in chamber 8, are now both in chamber 8. To provide complete mixing of these fluids, the locking plate is lowered, and the rotor is caused to accelerate and decelerate alternately for 10-20 seconds, as illustrated in figure 4c. The precipitating agent causes the fibrinogen/Factor XIII to separate from the plasma, and this separation is assisted by centrifuging the contents of the container a second time. This second centrifugation may be for a period of about five minutes. A fibrinogen pellet 48 is, thus, formed in the bottom of the chamber 8, as illustrated in figure 4d. At this stage ofthe process, the plasma supernatant 46 remains in chamber 8.

[0046] Plasma 46 is separated from the fibrinogen pellet 48 by stopping rotation of the centrifuge rotor to allow the container to pivot to the upright position shown in figures 3a and 4e. The locking plate 36 is then activated to lock the container in that orientation by engagement with protuberance 42, and the container is again rotated by the rotor for a period of about three to eight seconds. This rotation causes the supernatant plasma 46 to flow back through channel 18 and into chamber 6 by centrifugal draining, as illustrated in figure 4e. Thus, the fibrinogen pellet and plasma have now been separated. As a final step, the container is subjected to another centrifugation illustrated in figure 4f for about fifteen seconds, whereby the fibrinogen pellet is forced into the bottom of the chamber 8.

[0047] The automated process for production of fibrinogen is at this point complete, and the fibrinogen pellet is preferably extracted from the container 8 by a syringe for further processing. For example, the fibrinogen may be reconstituted and combined with thrombin to produce a sealant or an adhesive.

[0048] The apparatus of the invention may be used for other automated processes. For example, another technique for the separation of fibrinogen from blood in accordance with the structure of the invention uses cryoprecipitation. According to this technique, plasma is frozen to a temperature of about minus 20°C, thawed, and then centrifuged to separate the fibrinogen from plasma. The multiple-decanting apparatus of this invention may be used to automate cryoprecipitation by inclusion of a temperature control device 50 in thermal contact with the centrifuge. The temperature control device may comprise any of several known structures, including liquid nitrogen or liquid oxygen based devices and refrigeration devices.

[0049] To effect automated cryoprecipitation, a sample of blood is placed in the first chamber 8, and the container is then placed in the centrifuge and subjected to a first centrifugation. The plasma is then drained into the second chamber 8, for example by gravity draining. The temperature control device is then activated first to freeze the plasma and then to allow the plasma to thaw. The thawed plasma is subjected to a second centrifugation, which separates fibrinogen from the remainder of the plasma. The supernatant plasma is then separated from the fibrinogen by draining it back into the first chamber, for example by centrifugal draining, whereby only fibrinogen remains in the second chamber. The container is then removed from the centrifuge, and the fibrinogen removed from it for use as described above. Of course, the freezethaw-centrifuge process may be carried out any number of times before the supernatant is drained back into the first chamber.

[0050] Modifications within the scope of the appended claims will be apparent to those of skill in the art.

Claims

1. Apparatus for treating physiological products comprising a container (4) having a base forming a plurality of sterile chambers (6, 8), each chamber (6,8) having a bottom and a top, **characterised in that** the container further comprises a bridge (7) connecting the two or at least two of the chambers (6,8) and arranged to provide a sterile fluid channel (18) from a first of the said two or at least two chambers (6) to a second of the said two or at least two chambers (8) when the container (4) is in a predetermined orientation, a lid (11) closing the top of each of the chambers (6,8), and openings (13, 15) that provide access to the chambers (6,8) while maintaining sterility.

2. Apparatus according to claim 1 **characterised in that** the plurality of sterile chambers (6,8) and the bridge (7) comprise a molded base part.

3. Apparatus according to claim 1 or claim 2, **characterised in that** the container (4) is substantially rigid.

4. Apparatus according to any preceding claim, **characterised in that** it further comprises a separation disk (20) in one of the chambers (6,8).

5. Apparatus according to any preceding claim, **characterised in that** the plurality of chambers (6,8) comprise first and second adjacent chambers (6, 8) having adjacent sidewalls and the bridge (7) is formed at the tops of the adjacent sidewalls.

6. Apparatus according to any preceding claim, **characterised in that** it further comprises a centrifuge (2) having a frame (32) removably receiving the container (4) and allowing the container (4) to assume a first orientation wherein a product in one of the chambers (6,8) is subjected to centrifugation, and the predetermined orientation wherein fluid in the said first of the said two or at least two chambers (6) flows along the fluid channel (18) to the second of the said two or at least two chambers (8).

7. Apparatus according to claim 6, **characterised in that** the frame (32) is pivotally mounted to a centrifuge rotor (30).

8. Apparatus according to claim 6 or claim 7, **characterised in that** it further comprises a locking plate (36) movable between free and locking positions and wherein the plate (36) allows the container (4) to assume the said first orientation when in the free position and holds the container (4) in the predetermined position when in the locking position.

9. Apparatus according to claim 8, **characterised in that** it further comprises an electromagnet (38) for moving the locking plate (36) to one of the locking and free positions.

10. Apparatus according to claim 8 read appendant to claim 7, **characterised in that** the locking plate (36) engages the frame (32).

11. Apparatus according to any one of claims 6 to 10, **characterised in that** the frame (32) further allows the container (4) to assume a second orientation wherein fluid in the second of the said two or at least two chambers (8) flows to the said first of the said two or at least two chambers (6).

12. Apparatus according to claim 11, **characterised in that** the fluid in the said first of the said two or at least two chambers (6) flows to the said second of the said two or at least two chambers (8) by gravity draining when the container (4) is in the predetermined orientation and fluid in the said second of the said two or at least two chambers (8) flows to the said first of the said two or at least two chambers (6) by centrifugal transfer when the container (4) is in the second orientation.

13. Apparatus according to claim 12, **characterised in that** it further comprises a locking plate (36) that moves between locking and free positions for controlling the orientation of the frame (32).

14. A method for automatic separation of components **characterised by** placing a sterile, unitary container (4) having first and second chambers (6,8) in a centrifuge (2), subjecting the container (4) to centrifugation, and locking the container (4) in a first orientation such that a supernatant in the said first chamber (6) flows into the said second chamber (8).

15. A method according to claim 14 **characterised in that** the container (4) is removable from the centrifuge (2).

16. A method according to claim 14 or claim 15, **characterised in that** it further comprises subjecting the container (4) to a second centrifugation.

17. A method according to claim 16, **characterised in that** it further comprises locking the container (4) in a second orientation such that a supernatant in the said second chamber (8) flows to the said first chamber (6).

18. A method according to claim 17, **characterised in that** the supernatant in the said first chamber (6) flows to the said second chamber (8) by gravity draining when the container (4) is in the said first

orientation and the supernatant in the said second chamber (8) flows to the said first chamber (6) by centrifugal transfer when the container (4) is in the said second orientation.

19. A method according to any one of claims 14 to 18, **characterised in that** it further comprises placing blood in the said first chamber (6).

20. A method according to claim 19, **characterised in that** it further comprises placing an agent for precipitating fibrinogen from plasma in the said second chamber (8).

Patentansprüche

1. Vorrichtung zum Behandeln von physiologischen Produkten, umfassend einen Behälter (4) mit einem eine Mehrzahl von sterilen Kammern (6,8) bildenden Unterteil, wobei jede Kammer (6,8) einen Boden und ein Oberteil besitzt, **dadurch gekennzeichnet, daß** der Behälter weiterhin eine Brücke (7), die die beiden oder mindestens zwei der Kammern (6,8) verbindet und so angeordnet ist, daß sie als steriler Flüssigkeitskanal (18) zwischen einer ersten der genannten zwei oder mindestens zwei Kammern (6) und einer zweiten der genannten zwei oder mindestens zwei Kammern (8) dienen kann, wenn der Behälter (4) sich in einer vorgegebenen Stellung befindet, einen Deckel (11), der das Oberteil einer jeden der Kammern (6,8) verschließt und Öffnungen (13,14), welche Zugang zu den Kammern (6,8) unter Aufrechterhaltung von Sterilität ermöglichen, aufweist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** die Mehrzahl von sterilen Kammern (6,8) und die Brücke (7) ein mit Hilfe einer Form erzeugtes Unterteil aufweisen.

3. Vorrichtung nach Anspruch 1 oder Anspruch 2, **dadurch gekennzeichnet, daß** der Behälter (4) im wesentlichen starr ist.

4. Vorrichtung nach einem der voranstehenden Ansprüche, **dadurch gekennzeichnet, daß** sie weiterhin eine Trennscheibe (20) in einer der Kammern (6,8) aufweist.

5. Vorrichtung nach einem der voranstehenden Ansprüche, ' **dadurch gekennzeichnet, daß** die Mehrzahl von Kammern (6,8) eine erste und eine zweite benachbarte Kammer (6,8) mit nahegelegenen Seitenwänden umfassen und die Brücke (7) an den Oberteilen der nahe beieinander liegenden Seitenwände gebildet ist.

6. Vorrichtung nach einem der voranstehenden Ansprüche, **dadurch gekennzeichnet, daß** sie weiterhin eine Zentrifuge (2) mit einem Rahmen (32) aufweist, der den Behälter (4) entnehmbar aufnimmt und es dem Behälter (4) ermöglicht, eine erste Stellung, in der ein Produkt in einer der Kammern (6,8) einer Zentrifugation unterworfen wird, und die vorgegebene Stellung, in der Flüssigkeit in der ersten der genannten beiden oder mindestens zwei Kammern (6) entlang des Flüssigkeitskanals (18) zu der zweiten der genannten zwei oder mindestens zwei Kammern (8) fließt, einzunehmen.

7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet, daß** der Rahmen (32) schwenkbar an einem Zentrifugenrotor (30) befestigt ist.

8. Vorrichtung nach Anspruch 6 oder Anspruch 7, **dadurch gekennzeichnet, daß** sie weiterhin eine Sperrplatte (36) aufweist, die zwischen einer freigebenden und einer fixierenden Position beweglich ist und worin die Platte (36) es in der freigebenden Position dem Behälter (4) ermöglicht, die genannte erste Stellung einzunehmen, und in der fixierenden Position den Behälter (4) in der vorgegebenen Stellung hält.

9. Vorrichtung nach Anspruch 8, **dadurch gekennzeichnet, daß** sie weiterhin einen Elektromagneten (38) zum Bewegen der Sperrplatte (36) zu einer der fixierenden bzw. der freigebenden Position aufweist.

10. Vorrichtung nach Anspruch 8 in Verbindung mit Anspruch 7, **dadurch gekennzeichnet, daß** die Sperrplatte (36) in Eingriff mit dem Rahmen (32) steht.

11. Vorrichtung nach einem der Ansprüche 6 bis 10, **dadurch gekennzeichnet, daß** der Rahmen (32) weiterhin dem Behälter (4) das Einnehmen einer zweiten Stellung ermöglicht, in der Flüssigkeit aus der zweiten der genannten zwei oder mindestens zwei Kammern (8) in die erste der genannten zwei oder mindestens zwei Kammern (6) fließt.

12. Vorrichtung nach Anspruch 11, **dadurch gekennzeichnet, daß** die Flüssigkeit aus der ersten der genannten zwei oder mindestens zwei Kammern (6) durch Abfließen mit Hilfe von Schwerkraft in die zweite der genannten zwei oder mindestens zwei Kammern (8) fließt, wenn sich der Behälter (4) in der vorgegebenen Stellung befindet und Flüssigkeit aus der zweiten der genannten zwei oder mindestens zwei Kammern (8) durch einen Transport mittels Zentrifugalkraft in die erste der genannten zwei oder mindestens zwei Kammern (6) fließt, wenn sich der Behälter (4) in der zweiten Stellung befindet.

13. Vorrichtung nach Anspruch 12, **dadurch gekennzeichnet, daß** sie weiterhin eine Sperrplatte (36) aufweist, die sich zwischen einer fixierenden Position und einer freigebenden Position bewegt, um die Stellung des Rahmens (32) zu steuern.

14. Verfahren zum automatischen Abtrennen von Bestandteilen, **gekennzeichnet durch** das Einbringen eines sterilen, einheitlichen Behälters (4) mit einer ersten und einer zweiten Kammer (6,8) in eine Zentrifuge (2), das Zentrifugieren des Behälters (4) und das Fixieren des Behälters (4) in einer ersten Stellung derart, daß ein Überstand in der genannten ersten Kammer (6) in die genannte zweite Kammer (8) fließt.

15. Verfahren nach Anspruch 14, **dadurch gekennzeichnet, daß** der Behälter (4) aus der Zentrifuge (2) entnehmbar ist.

16. Verfahren nach Anspruch 14 oder Anspruch 15, **dadurch gekennzeichnet, daß** es weiterhin ein zweites Zentrifugieren des Behälters (4) umfaßt.

17. Verfahren nach Anspruch 16, **dadurch gekennzeichnet, daß** es weiterhin das Fixieren des Behälters (4) in einer zweiten Stellung umfaßt, derart, daß ein Überstand in der zweiten Kammer (8) in die erste Kammer (6) fließt.

18. Verfahren nach Anspruch 17, **dadurch gekennzeichnet, daß** der Überstand in der ersten Kammer (6) durch Abfließen mit Hilfe von Schwerkraft in die zweite Kammer (8) fließt, wenn sich der Behälter (4) in der genannten ersten Stellung befindet, und der Überstand in der zweiten Kammer (8) durch Zentrifugalkraft-Transport in die erste Kammer (6) fließt, wenn sich der Behälter (4) in der zweiten Stellung befindet.

19. Verfahren nach einem der Ansprüche 14 bis 18, **dadurch gekennzeichnet, daß** es weiterhin das Einbringen von Blut in die erste Kammer (6) umfaßt.

20. Verfahren nach Anspruch 19, **dadurch gekennzeichnet, daß** es weiterhin das Einbringen eines Mittels zum Ausfällen von Fibrinogen aus Plasma in die zweite Kammer (8) umfaßt.

Revendications

1. Appareil pour le traitement de produits physiologiques, comprenant un récipient (4) ayant une base qui forme une pluralité de chambres stériles (6, 8), chaque chambre (6, 8) ayant un fond et un sommet, **caractérisé en ce que** le récipient comprend en outre un pont (7) reliant les deux chambres ou au moins deux des chambres (6, 8) et agencé de manière à définir un canal de fluide stérile (18) allant d'une première des dites deux ou au moins deux chambres (6) à une deuxième des dites deux ou au moins deux chambres (8) lorsque le récipient (4) est dans une orientation prédéterminée, un couvercle (11) fermant le sommet de chacune des chambres (6, 8), et des trous (13, 15) qui donnent accès aux chambres (6, 8) tout en conservant la stérilité.

2. Appareil selon la revendication 1, **caractérisé en ce que** la pluralité de chambres stériles (6, 8) et le pont (7) comprennent une partie de base moulée.

3. Appareil selon la revendication 1 ou la revendication 2, **caractérisé en ce que** le récipient (4) est sensiblement rigide.

4. Appareil selon une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend en outre un disque de séparation (20) dans une des chambres (6, 8).

5. Appareil selon une quelconque des revendications précédentes, **caractérisé en ce que** la pluralité de chambres (6, 8) comprend une première et une deuxième chambres adjacentes (6, 8) ayant des parois latérales adjacentes, et le pont (7) est formé aux sommets des parois latérales adjacentes.

6. Appareil selon une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend en outre une centrifugeuse (2) ayant un cadre (32) qui reçoit le récipient (4) de façon amovible et permet au récipient (4) de prendre une première orientation, dans laquelle un produit contenu dans une des chambres (6, 8) est soumis à une centrifugation, et la dite orientation prédéterminée dans laquelle le fluide contenu dans la dite première chambre des dites deux ou au moins deux chambres (6) s'écoule le long du canal de fluide (18) vers la deuxième des dites deux ou au moins deux chambres (8).

7. Appareil selon la revendication 6, **caractérisé en ce que** le cadre (32) est monté de façon pivotante sur un rotor de centrifugeuse (30).

8. Appareil selon la revendication 6 ou la revendication 7, **caractérisé en ce qu'**il comprend en outre une plaque de verrouillage (36) déplaçable entre une position libre et une position de verrouillage, et dans lequel la plaque (36) permet au récipient (4) de prendre la dite première orientation lorsqu'elle est dans la position libre et elle maintient le récipient (4) dans la dite position prédéterminée lorsqu'elle est dans la position de verrouillage.

9. Appareil selon la revendication 8, **caractérisé en**

ce qu'il comprend en outre un électroaimant (38) pour amener la plaque de verrouillage (36) à une de la position de verrouillage et de la position libre.

10. Appareil selon la revendication 8, lorsqu'elle dépend de la revendication 7, **caractérisé en ce que** la plaque de verrouillage (36) vient en prise avec le cadre (32).

11. Appareil selon une quelconque des revendications 6 à 10, **caractérisé en ce que** le cadre (32) permet en outre au récipient (4) de prendre une deuxième orientation dans laquelle le fluide contenu dans la deuxième des dites deux ou au moins deux chambres (8) s'écoule vers la dite première des dites deux ou au moins deux chambres (6).

12. Appareil selon la revendication 11, **caractérisé en ce que** le fluide dans la dite première des dites deux ou au moins deux chambres (6) s'écoule vers la dite deuxième des dites deux ou au moins deux chambres (8) par drainage gravitaire lorsque le récipient (4) est dans l'orientation prédéterminée, et le fluide contenu dans la dite deuxième des dites deux ou au moins deux chambres (8) s'écoule vers la dite première des dites deux ou au moins deux chambres (6) par transfert centrifuge lorsque le récipient (4) est dans la deuxième orientation.

13. Appareil selon la revendication 12, **caractérisé en ce qu'**il comprend en outre une plaque de verrouillage (36) qui se déplace entre une position de verrouillage et une position libre pour commander l'orientation du cadre (32).

14. Procédé pour la séparation automatique de composants, **caractérisé en ce qu'**on place un récipient unitaire stérile (4) ayant une première et une deuxième chambres (6, 8) dans une centrifugeuse (2), on soumet le récipient (4) à une centrifugation, et on bloque le récipient (4) dans une première orientation de sorte qu'une couche surnageante dans la dite première chambre (6) s'écoule vers la dite deuxième chambre (8).

15. Procédé selon la revendication 14, **caractérisé en ce que** le récipient (4) peut être enlevé de la centrifugeuse (2).

16. Procédé selon la revendication 14 ou la revendication 15, **caractérisé en ce qu'**il comprend en outre la soumission du récipient (4) à une deuxième centrifugation.

17. Procédé selon la revendication 16, **caractérisé en ce qu'**il comprend en outre le verrouillage du récipient (4) dans une deuxième orientation telle qu'une couche surnageante dans la dite deuxième chambre (8) s'écoule vers la dite première chambre (6).

18. Procédé selon la revendication 17, **caractérisé en ce que** la couche surnageante dans la dite première chambre (6) s'écoule vers la dite deuxième chambre (8) par drainage gravitaire lorsque le récipient (4) est dans la dite première orientation, et la couche surnageante dans la dite deuxième chambre (8) s'écoule vers la dite première chambre (6) par transfert centrifuge lorsque le récipient (4) est dans la dite deuxième orientation.

19. Procédé selon une quelconque des revendications 14 à 18, **caractérisé en ce qu'**il comprend en outre l'introduction de sang dans la dite première chambre (6).

20. Procédé selon la revendication 19, **caractérisé en ce qu'**il comprend en outre l'introduction d'un agent pour précipitation du fibrinogène à partir du plasma, dans la dite deuxième chambre (8).

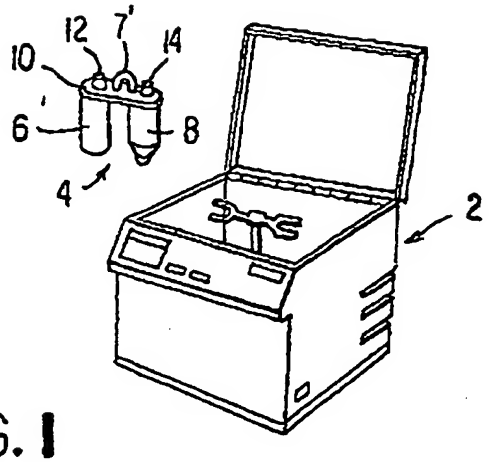

FIG. 1

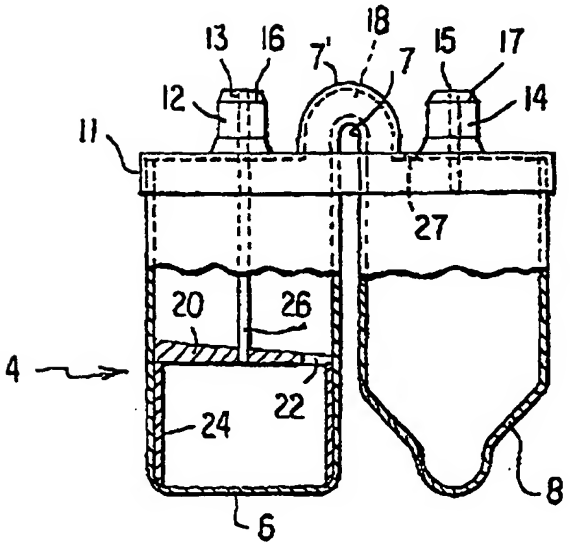

FIG. 2

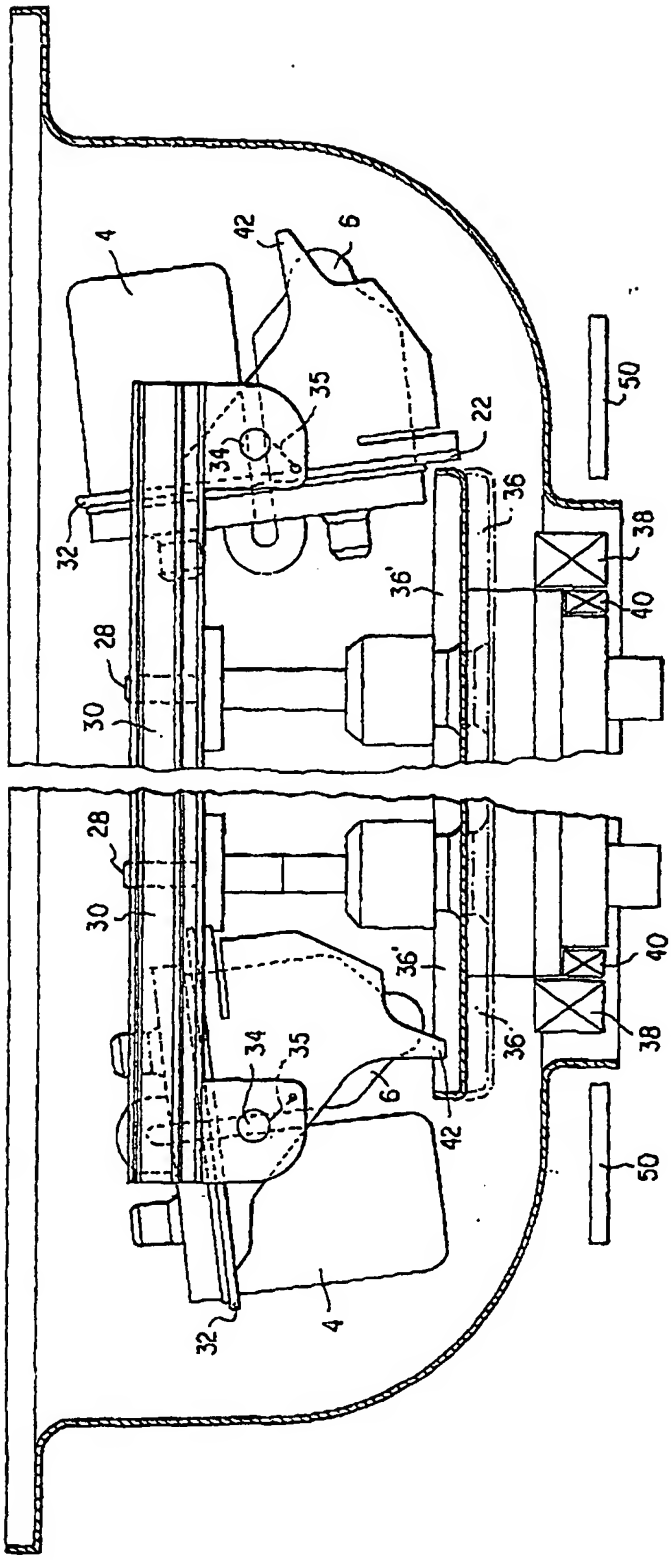
4
42
6
35
22
34
32
36
38
50
36'
40
28
30
28
30
36'
40
34
35
36
38
6
42
50
32
4

FIG. 3b

FIG. 3a

FIG. 4a

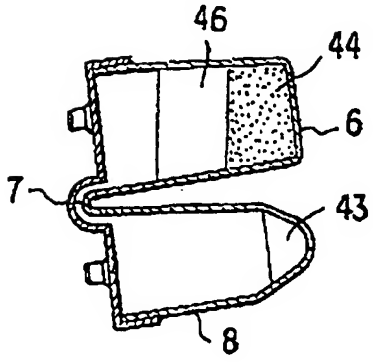

FIG. 4b

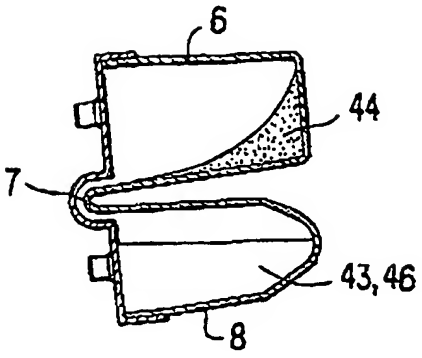

FIG. 4c

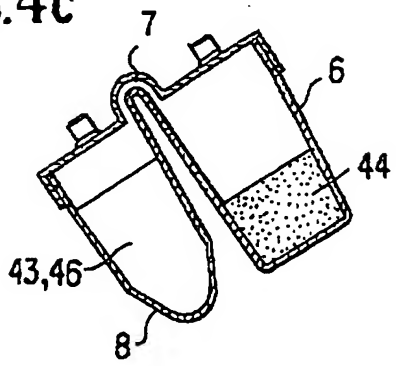

FIG. 4d

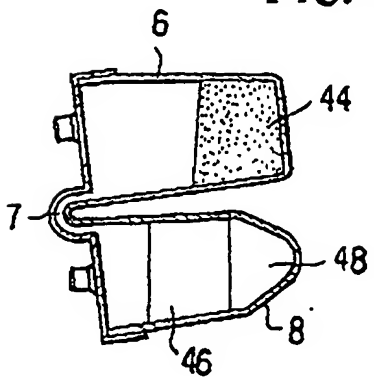

FIG. 4e

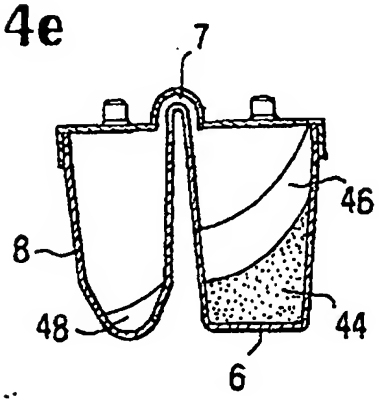

FIG. 4f